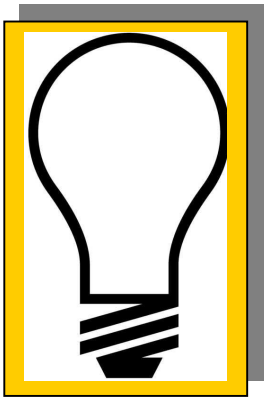
Dynamic Design: A Collection Process

Concentrate

TEACHER GUIDE

BACKGROUND INFORMATION



In this activity students will study the solar wind concentrator in the Genesis sample return capsule. They will then design a mirror model for the concentrator. The concentrator contains an entry grid that is positively charged to repel hydrogen ions. It also has a parabolic mirror grid to reflect the solar wind particles to the carbon vapor deposit gold-plated diamond target. Students will model the concentrator by using a plastic bowl lined with a reflective material (aluminum foil) for the mirror grid, polarized paper will represent the entry grid, a solar panel will represent the target, and a light bulb will provide "solar wind particles." (Note: Light is not a perfect model for solar wind materials because solar wind is made up of different elements and ions. The purpose of this activity is to model the concentrator. As noted in the student text, photons are reflected out of the concentrator. After reading the text, students will describe how this model is limited.) Polarized paper is used to simulate the entry grid and can be manipulated such that only a certain amount of light gets into the concentrator.

NATIONAL SCIENCE STANDARDS ADDRESSED

Grades 5-8

Science as Inquiry
Abilities necessary to do scientific Inquiry
Physical Science
Transfer of Energy
Science and Technology
Understanding about science and technology

Grades 9-12

Science as Inquiry
Abilities necessary to do scientific inquiry
Physical Science
Interactions of energy and matter
Science and Technology
Abilities of technological design
Understandings about science and technology

MATERIALS

For each group of three to four students:

- At least one small plastic butter container with lid
- Enough aluminum foil or other reflective material to line the bottom of the container
- Solar cell with light bulb
- Wire mesh with different sized holes or Polaroid film square (and IR filter)
- (Optional) Parabolic reflector demonstrator
- (Optional) Single rotator radiometer
- Light source (at least 100 watt)
- Student Text: "The Concentrator"
- (Optional) Student Activity: "Hot Dog Cooker"

PROCEDURE

1. Ask students if they know the most common element found in the universe. Discuss potential answer. Explain that hydrogen is the most common element found in the universe, in the sun, and other stars.

2. Since solar wind is made up mostly of hydrogen, ask students, "What would be a method of separating the hydrogen from the other solar wind particles?" Allow students time in their small groups to discuss and present an answer to this question. Some students may choose filtering, or other "physical" means of separating the hydrogen from the other particles. Have the students read the student text, "The Concentrator."

Alternate Strategy Tip

Constructing a solar cooker is a fun class activity. For a low-cost, step-by-step, illustrated set of instructions that include many common household materials, see the "Hot Dog Cooker" student activity.

3. Explain that the Genesis sample return capsule (SRC) will contain a concentrator that will repel the hydrogen ions (protons) and focus the remaining solar wind on a target. Explain that the concentrator will be using technology that has never been used before. This technology will enhance the ability of the Genesis scientists to learn about solar wind first-hand.

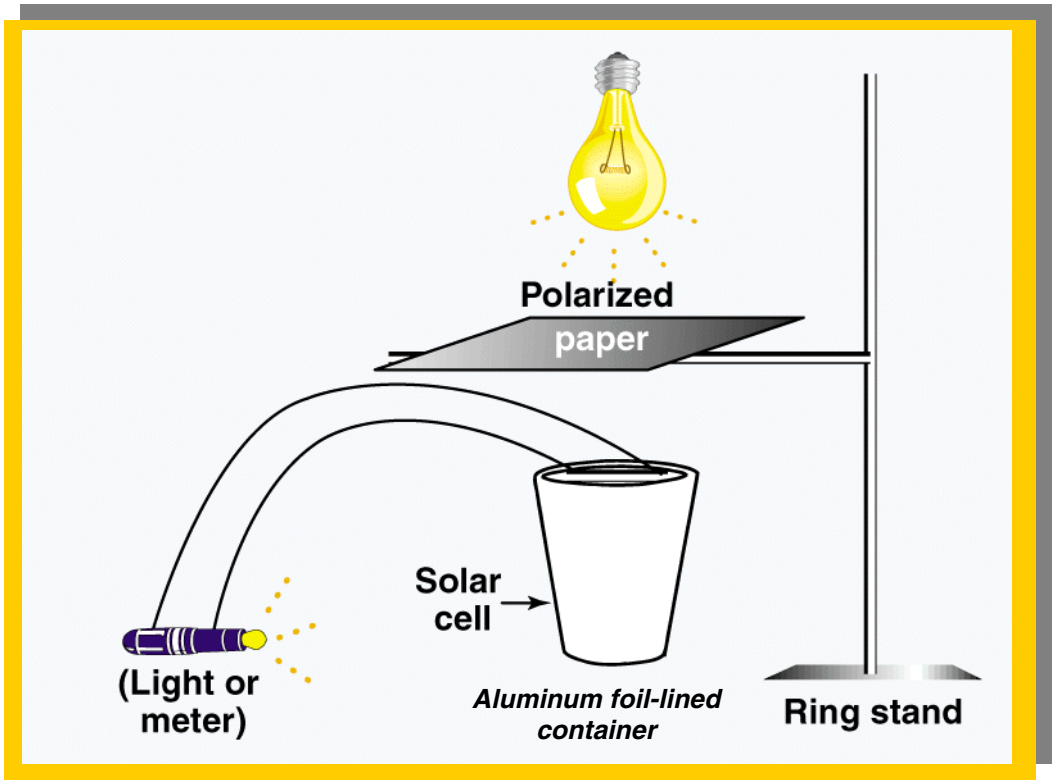
4. Tell students that they will design a concentrator that will model this process. Explain that the model will use a bowl-shaped container lined with aluminum foil to represent the mirror grid and polarized paper to model the entry grid. The solar cell will represent the CVD target material. Show the diagram of the concentrator and point out the different parts. (Optional) Also show how the parabolic reflector works by shining a light into the demonstrator.

5. Demonstrate the Polaroid® paper on the overhead projector for reviewing the process skills of observation and inference. Place two pieces of Polaroid® paper on the overhead projector side by side. Ask students to make two observations. Then place the Polaroid® paper one on top of the other such that the overlap is gray not black. Ask students to make two more observations. While the Polaroid® paper is overlapped, slowly rotate one of the papers until the overlapped section turns black. Ask students to make one more observation and an inference. Remind students that an inference is a logical explanation of an observation.

6. Make the supplies available for the students to complete the concentrator. Circulate around the room providing assistance for students who do not understand the procedure.

   Student Procedure:
   1. Your group is going to design a model of a concentrator, using the supplies given.
   2. Before you begin the model what decisions do you need to make?
      — How will you line the plastic container?
      — Which side of the aluminum foil will be facing up?
      — How smooth will the foil be?
      — Where will the solar cell be located?
      — How will the solar cell be suspended?
      — How will the Polaroid® paper be used? What other decisions need to be made?
   3. Once your group is ready, start construction of the concentrator.
   4. Use a light source to test how well your concentrator works. Then use the Polaroid® paper to manipulate the amount of light that enters the concentrator.
   5. Try another type of reflective material or try the single rotator radiaometer or try IR filters to model the concentrator.
   6. Make a data table to record decisions and qualitative data observations from your model.

7. Once students have completed their models, have each group briefly demonstrate their model and explain the various components. Ask each group how having different technologies available affected their ability to collect light in a controlled manner.


Polarized
paper
Solar
cell
(Light or
meter)
Aluminum foil-lined
container
Ring stand
McREL